

Mantle Helium Along the Newport-Inglewood Fault Zone, Los Angeles Basin, California -- A Leaking Paleo-Subduction Zone

J. R. Boles¹, G. Garven², H. Camacho³, and J. E. Lupton⁴

¹*J. R. Boles, Department of Earth Science, UCSB, Santa Barbara, CA 93106*

²*G. Garven, Department of Earth and Ocean Sciences, Tufts Univ., Medford, MA 02155*

³*H. Camacho, Occidental Oil and Gas Corporation, Houston, TX 77046*

⁴*J. E. Lupton, NOAA Pacific Marine Environmental Laboratory, Newport, OR 97365*

Corresponding author:

James Boles, Dept. of Earth Science, Webb Hall, Univ. Calif. Santa Barbara, Santa Barbara, CA 93106. e-mail: boles@geol.ucsb.edu

ABSTRACT

Mantle helium is a significant component of the helium gas from deep oil wells along the Newport-Inglewood fault zone (NIFZ) in the Los Angeles (LA) basin. Helium isotope ratios are as high as 5.3 Ra (Ra=³He/⁴He ratio of air) indicating 66% mantle contribution, (assuming R/Ra = 8 for mantle), and most values are higher than 1.0 Ra. Other samples from basin margin faults and from within the basin have much lower values (R/Ra < 1.0). The ³He enrichment inversely correlates with CO₂, a potential magmatic carrier gas. The δ¹³C of the CO₂ in the ³He rich samples is between 0 and -10 ‰, suggesting a mantle influence. The strong mantle helium signal along the NIFZ is surprising considering that the fault is currently in a transpressional rather than extensional stress regime, lacks either recent magma emplacement or high geothermal gradients, and is modeled as truncated by a proposed major, potentially seismically active, décollement beneath the LA basin. Our results demonstrate that the NIFZ is a deep-seated fault directly or indirectly connected with the mantle. Based on a 1-D model, we calculate a maximum Darcy flow rate $q \sim 2.2$ cm/yr and a fault permeability $k \sim 6 \times 10^{-17}$ m² (60

microdarcys), but the flow rates are too low to create a geothermal anomaly. The mantle leakage may be a result of the NIFZ being a former Mesozoic subduction zone in spite of being located 70 km west of the current plate boundary at the San Andreas fault.

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